HARDWARE REFERENCE MANUAL

16-Axis MACRO CPU

Preliminary Documentation

16-Axis MACRO CPU

4Ax-603719-xHxx

April 21, 2010

CE

DELTA TAU
Data Systems, Inc.
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REVISION HISTORY				
REV.	**DESCRIPTION**	**DATE**	**CHG**	**APPVD**
1	ADDED CE DECLARATION OF CONFORMITY	08/23/06	CP	S. FIERRO
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INTRODUCTION

The 16-Axis MACRO CPU board is the processor and MACRO interface board used in a 3U MACRO Station (in either UMAC MACRO or MACRO Stack configuration).

Note:

There are three documents that describe the operation of 3U MACRO Station products:

- UMAC System Manual (General Product Overview)
- MACRO 16 Station User's Manual
- MACRO 16 Station Software Reference

This manual describes the interfaces and physical hardware that is used on the 3U MACRO CPU.

The UMAC 16-Axis MACRO CPU provides a remote interface for encoders, flags, direct-PWM digital drives, analog drives, stepper drives, analog I/O, and digital I/O for Delta Tau Data's PMAC products that have a MACRO interface.

The UMAC 16-Axis MACRO CPU configurations communicate with PMAC2 Ultralites or Turbo PMAC2 Ultralites solely through the MACRO ring, interfacing to standard drives, encoders, flags, and I/O through on-board connectors. In almost every case, a Turbo Ultralite or UMAC CPU with Acc-5E will be used as the MACRO Master. This 16-Axis MACRO CPU integrated packaging and connectivity strategy provides revolutionary flexibility and ease of use.

A 16-Axis MACRO CPU consists of a set of 3U format Euro-cards (100 x 160 mm) that can be assembled in a variety of configurations. When used in the rack configuration, connected through a backplane bus, the backplane is UBUS format, designed by Delta Tau Data Systems Inc. for motion control and I/O interfaces.

When using the fiber optic MACRO interface, the 3U MACRO Station can be up to three kilometers (two miles) away from the PMAC2 Master controller or any other station on the ring. When using the RJ-45 copper electrical interface, it can be up to 30 meters (100 feet) away.

The 16-Axis MACRO CPU Station allows PMAC2 MACRO controllers to control servo axes and I/O just as if they were connected directly to the PMAC2, even though they may be a great distance away. The only interface needed from the PMAC2 is the electrically isolated MACRO ring.

Typically, a PMAC2 Turbo Ultralite board, one without any of its own servo interface circuitry, is used with the MACRO Station to provide the most cost-effective solution.

16-Axis MACRO CPU 3U Board (3A0-603719-10x):

- 100MHz DSP56309 CPU
- 512k x 8 flash memory for user backup and firmware
- Latest released firmware version
- RS-232 serial interface for setup and debugging
- UBUS connector for backplane connection to servo and I/O accessory boards
- JHW H/W Pulse/Dir port with 20-pin IDC header
- JDISP Standard PMAC Display 14-pin header.

The 16-Axis MACRO CPU can only be configured as a UMAC MACRO configuration. The older generation MACRO8 CPU can be used as either a UMAC MACRO or a MACRO Stack.

UMAC MACRO – In this configuration (once called Pack) the 3U-format boards are put together to communicate through a backplane bus called the UBUS. All boards are installed in a Euro-card rack. In this configuration, all 3U-format boards or modules can be installed or withdrawn from the pack individually, providing ease of installation, debugging, and repair.

The photo at the upper right shows a UMAC rack with power supply and I/O boards that are connected through a backplane. This system allows for an easier integration of the 3U 16x MACRO CPU for larger (up to 16 axes) applications.

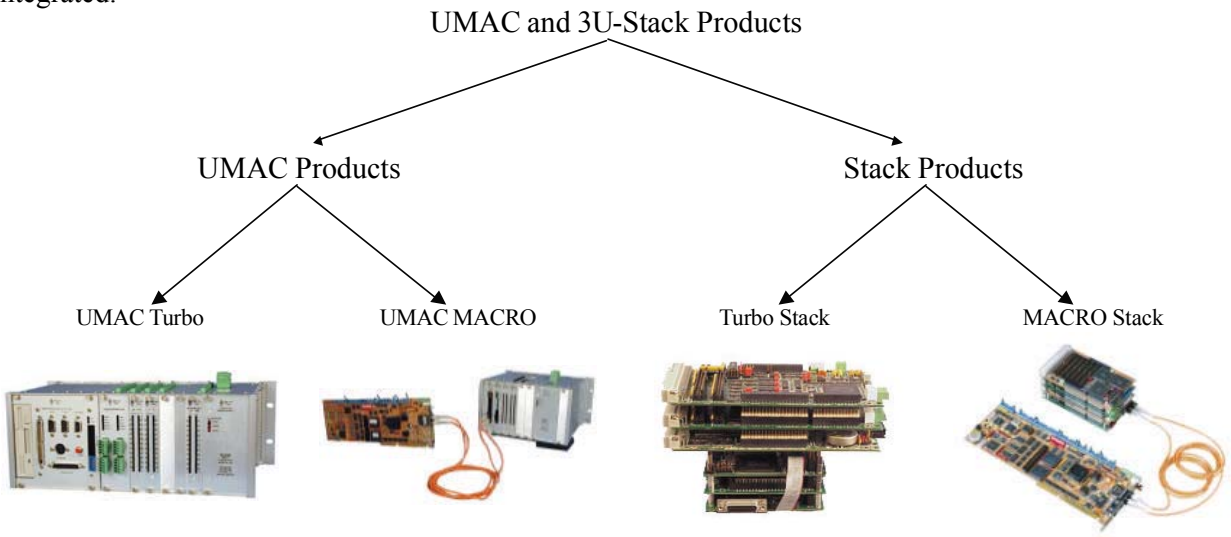
UMAC MACRO Station Configuration

3U Product Configurations (General Description)

Assemblies of 3U-format boards can be made with either of two CPU processor boards – a 3U MACRO CPU board, or a 3U Turbo PMAC2 CPU board. Most other 3U-format boards, labeled Accessory boards, can be used with either CPU board.

- When the 3U 16-Axis MACRO CPU board is used, the resulting assemblies are called UMAC MACRO or 3U MACRO Stack.
- When the 3U Turbo PMAC2 CPU board is used, the resulting assemblies are called UMAC Turbo or Turbo Stack.

Refer to the UMAC Product Guide for more detailed descriptions of how the rack and stack products are integrated.



The UMAC Turbo is composed of a 3U-format Turbo PMAC2 CPU board and a set of accessory boards in 3U-format, all plugged in a common UBUS backplane and installed inside a 3U format rack. A PC/104 computer and several optional communication accessories (including all of the major FieldBuses, MACRO and Ethernet) can be installed inside the UMAC system providing convenient flexibility and virtually unlimited expandability.

The UMAC MACRO is composed of a MACRO Interface/CPU board and a set of accessory boards in 3U-format, all plugged in a common UBUS backplane and installed inside a 3U format rack. The UMAC MACRO must receive commands from an external MACRO compatible device like a PMAC2 Ultralite or a UMAC Turbo system. The UMAC MACRO does not support a PC/104 or communication accessories and it is preferred for distributed control over a MACRO ring connection.

The Turbo stack is composed of a 3U-format Turbo PMAC2 CPU board and a set of accessory boards in 3U-format plugged to it in a stack configuration. The Turbo stack configuration is less expensive than the UMAC Turbo system but it is limited to eight axes of motion control versus 32 axes on a UMAC Turbo system. The Turbo Stack is selected over a UMAC Turbo system because is more compact, allowing its installation inside already existing cabinets with some space limitations.

The MACRO stack is composed of a MACRO Interface/CPU board and a set of accessory boards in 3U-format plugged to it in a stack configuration. The UMAC MACRO must receive commands from an external MACRO compatible device like a PMAC2 Ultralite or a UMAC Turbo system. The MACRO Stack is selected over a UMAC MACRO system because it is more compact, allowing its installation inside already existing cabinets with some space limitations.

Configuration

The purchase of the 3U 16-Axis MACRO CPU board provides a 3U-format (100mm x 160mm) board with a DSP processor, MACRO ring circuitry, and a backplane connector through which other 3U-format boards can be connected by means of a UBUS passive-backplane board.

The 3U 16-Axis MACRO CPU can be purchased in two physical configurations, distinguished by part number prefix:

- **300-603719-10x** provides the 16-Axis MACRO CPU board without a front plate. This configuration is recommended for stack assemblies.
- **3A0-603719-10x** provides the 16-Axis MACRO CPU board with a front plate. This configuration is recommended for UMAC rack assemblies. The top and bottom plates are provided with the Acc-Px rack.

There are a few options available for the 16-Axis MACRO CPU board.

One of the Options A or C must be present on a 16-Axis MACRO CPU board to provide the actual MACRO ring interface circuitry; both may be present:

Option A provides an SC-style fiber-optic transceiver to connect into the MACRO ring. Its main component is the U73 transceiver.

Option C provides RJ-45 electrical input and output connectors for the MACRO ring. Its main components are J14 and J17.

Option 10 permits a specified revision of the MACRO Station firmware to be installed in the flash memory in the card. Without this option, the latest released revision is installed. A label on the flash memory IC indicates the firmware revision installed at the factory (but not necessarily which revision is presently installed in the IC). The presently installed revision can be ascertained by using the **`MSVER{node #}`** command.

SPECIFICATIONS

Environmental Specifications

Description	Specification	Notes
Operating Temperature	0°C to 45°C,	
Storage Temperature	-25°C to 70°C	
Humidity	10% to 95 % non-condensing	

Physical Specifications

Description	Specification	Notes
Dimensions	Length: 16.256 cm (6.4 in.) Height: 10 cm (3.94 in.) Width: 2.03 cm (0.8 in.)	
Weight	188 g	Front Plate included
The width is the width of the front plate. The length and height are the dimensions of the PCB.		

Electrical Specifications

Description	Specification	Notes
Power Requirements	5V @ 2.5A (±10%)	

EMC and Safety

Item	Description
CE Mark	Full Compliance
EMC	EN55011 Class A Group 1 EN61000-3-2 Class A EN61000-3-3 EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-11
Safety	EN 61010-1
Flammability Class	UL 94V-0

HARDWARE SETUP

The hardware setup of the 3U 16-Axis MACRO CPU Board consists of the setting of two rotary switches, the setting of several E-point jumpers on each board, followed by power supply and signal connections.

> ***Note:***
>
> E-Point Jumper numbers are shown in white ink on the legend of each board. Pin numbers for each jumper can be determined either from the legend on the component side on the board or by looking at the solder side of the board, where pin 1 has a square solder pad.

Board Jumper and Switch Summary

The MACRO Station has two 16-way rotary switches on the 16-Axis MACRO CPU board that establish the station's basic configuration on the MACRO ring.

SW1 Rotary Switch Setting: SW1 establishes how many servo nodes and which servo nodes, will be used on the MACRO station MACRO IC 0. It also establishes the mapping of MACRO node numbers to MACRO Station channel numbers. This mapping information will be important in establishing the software setup. More detailed information on the SW1 settings is presented in the Jumper/Switch description in the back of this manual.

SW2 Rotary Switch Setting: SW2 establishes the number of the master IC to which the MACRO station will respond. The values of 0 to 15 correspond to Master numbers 0 to 15, respectively. For a non-Turbo PMAC2 master, this value must match the master number value in the first hexadecimal digit of PMAC2's I996. For a Turbo PMAC2, this value must match the master number value in the first hexadecimal digit of the Turbo PMAC2's I6840, I6890, I6940, or I6990, for MACRO ICs 0, 1, 2, or 3, respectively, on the Turbo PMAC2. The default switch setting is 0, so the station will respond to Master 0.

Watchdog Timer Enable Jumper: For normal operation of the Compact MACRO Station, jumper E1 should be OFF to enable the watchdog timer (an important safety feature).

Operational Mode Jumper: Jumper E2 should connect pins 2 and 3 to tell the CPU it is in normal operational mode, not in bootstrap mode. To load new firmware into the flash IC through the serial port, it should only connect pins 1 and 2.

Baud Rate Jumper: Jumper E3 must be ON if connecting an Acc-8D Option 9 Yaskawa absolute encoder converter to the J7 serial port (most will connect it to the JTHW port instead). This sets the baud rate to 9600. If E3 is OFF, the baud rate is 38400.

Power Supply Check Jumper: Remove jumper E4 if not bringing a +/-12V to +/-15V supply into the Compact MACRO Station itself (5V only). If bringing these analog circuit supplies into the Compact MACRO Station, have jumper E4 on so that the servo outputs are disabled if either of the analog supplies is lost.

MACRO Input Select Jumper: Because the 16-Axis MACRO CPU board can accept MACRO ring input from either the RJ-45 electrical input or the fiber input, select which input is used (even if only one of the ring interface options is present). Jumper E40 must be ON to use the fiber input; it must be OFF to use the electrical input. (If both interface options A and C are present, either ring output may be used, regardless of the setting of E40.)

Board Connections

The connection of Compact MACRO Station to other stations on the MACRO ring is achieved by connecting the output connector of the Compact MACRO Station to the input connector of the next station, and by connecting the output connector of the previous station to the input connector of the Compact MACRO Station. There must be a completely connected ring with all stations powered up, for any communications to occur on the ring.

Connector Summary

The connectors on the 16-Axis MACRO CPU are found on both the main (603719-10x) board and on an I/O daughter card (603720-10x) that plugs into the main board.

Main Board Connections (603719)

J4: *	JISP: For Factory use only
J14, J17:	RJ45: MACRO Copper I/O (OPT C)
P1:	JEXP: Backplane Expansion Port Connector
TB1:	JPWR: 4-Pin Terminal Block
TB2:	JWD: Watchdog Relay Terminal block
U73:	MACRO Fiber Optic Connector (OPT A)

***** Typically, these connectors are not designated as end-user interfaces. The pinouts are not included in this hardware reference manual. Consult the factory if pinout information is needed.

I/O Daughter Board Connections (603720)

J2: *	JDISP: 40x2 Segment Display Connector
J3:*	JHW: Two channel handwheel encoder /Two Channel Pulse/Direction Outputs
J4: *	JRS232: RS232 Serial Communication port

***** Typically, these connectors are not designated as end-user interfaces. The pinouts are not included in this hardware reference manual. Consult the factory if pinout information is needed.

Optical Fiber Ring Connection: The U73 integrated fiber optic transceiver is used for both the optical fiber input and the optical fiber output connections to the MACRO ring. With the component side of the board up and the opening facing front, the input socket is on the right, and the output socket is on the left (these are marked on the component).

RJ45 Electrical Ring Connection: The J14 connector is used for the input from the previous station on the MACRO ring if electrical connection is used and the J17 connector is used for the output to the next station on the MACRO ring.

Backplane UBUS Expansion Port: The P2 96-pin DIN header is used to connect to expansion port accessories such as the Acc-9E, 10E, 11E, 12E, and 14E I/O boards, or the Acc-24E2x axis boards, through an Acc-Ux UBUS backplane board. It can be used also to bring in 5V power, and optionally +/-15V power, from a backplane or breakout board to the entire MACRO Station.

Power Terminal Block: The TB1 4-point terminal block can be used to bring in 5V power and optionally +/-15V power to the entire MACRO Station. In a UMAC (pack) configuration, usually the power is brought in through the backplane.

Watchdog Terminal Block: The TB2 4-point terminal block can be used to send normally opened or open normally closed circuits in the event of a watchdog failure at the 16-Axis MACRO CPU.

Hardware Re-initialization

MACRO hardware re-initialization to factory defaults is enabled when the SW1 setting is set to 15 or F (hexadecimal) and the power is cycled at the MACRO Station. The only time to use a hardware re-initialization to factory defaults with the MACRO Station would be if the MACRO Station always powers up with a watchdog (typically if the ring clock at the Ultralite is different from the ring clock at the MACRO Station). Node 11 will be the only MACRO Station node enabled. Therefore, enable node 11 of the MACRO IC at the Ultralite to communicate to the MACRO Station.

Ultralite Example: Servo nodes 0,1,4,5 enabled at Ultralite (I996=$0F8033)

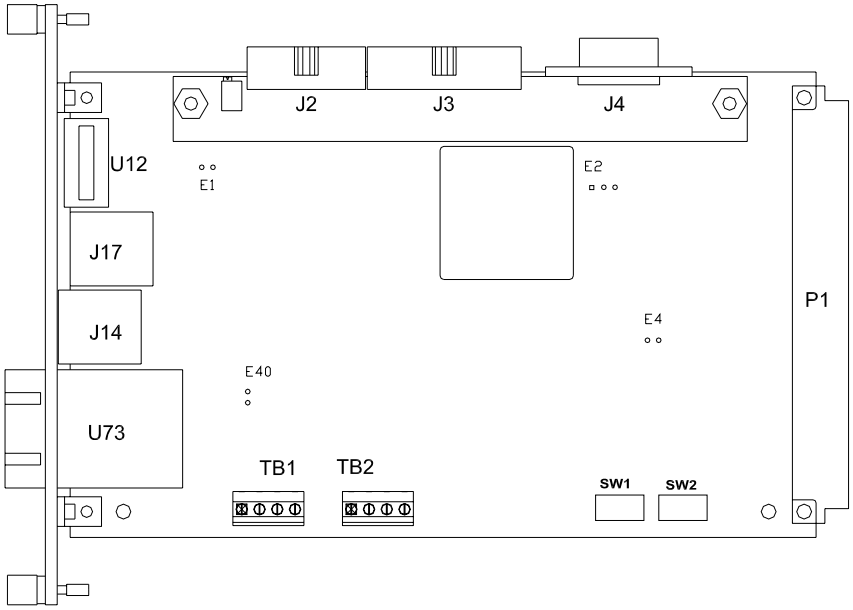
1. Enable node 11, I996=$0F8833.
2. Then reestablish communications with MS11,(MIvar) commands.
3. Issue **`MS$$$***11`** command to ensure re-initialization.
4. Issue **`MSSAVE11`** command to save the factory defaults to the Station.

Turbo Ultralite Example: Servo nodes 0,1,4,5 enabled at Ultralite (I6841=$0F8033)

1. Enable node 11, I996=$0F8833.
2. Then reestablish communications with MS11,(MIvar) commands.
3. Issue **`MS$$$***11`** command to ensure re-initialization.
4. Issue **`MSSAVE11`** command to save the factory defaults to the Station.

JUMPER AND SWITCH CONFIGURATIONS

Layout



Jumper Descriptions

E1: Watchdog Timer Disable

Jumper Type	Description	Default
2-Pin	Remove jumper to enable Watchdog Timer. Jump pins 1 and 2 to disable Watchdog Timer (for test purposes only).	not jumpered

E2: CPU Mode Operation

Jumper Type	Description	Default
3-Pin	Jump pins 1 and 2 for firmware download through serial port. Jump pins 2 and 3 for normal operation.	Pin 2-3

E3: Serial Port Baud Rate

Jumper Type	Description	Default
2-Pin	Jump pins 1 and 2 for 9600-baud serial port operation. Remove jumper for 38400 Baud.	not jumpered

E4: Power Supply-Loss Control (±15Vdc Supply Monitor)

Jumper Type	Description	Default
2-Pin	Jump pins 1 and 2 to disable servo outputs on loss of +5V, +15V, or –15V power supply. Remove this jumper to monitor +5Vdc power supply only. Usually, ±15V supply monitoring is not required for applications without DACs or A-D converters.	not jumpered

E40: MACRO Input (Fiber/Wired) Selector

Jumper Type	Description	Default
2-Pin	Remove jumper to select MACRO wired (RJ45) input from J14. Jump pins 1 and 2 to select MACRO fiber optic input from U73.	Jumpered (Option A) Not jumpered (Option C)

Switch Configurations

SW1: MACRO Slave Node Configure

SW1 Select	I/O Nodes Enabled	Servo Nodes Enabled	Node Servo IC Base Address	Nodes Enabled	Y:I181…188
0	0	4	$8000,$8008, $8010,$8018	0,1, 4,5	I181, I182, I183, I184
1	0	4	$8000,$8008, $8010,$8018	8,9, 12,13	I185, I186, I187, I188
2	0	2	$8000,$8008	0,1	I181, I182
3	0	2	$8000,$8008	4,5	I183, I184
4	0	2	$8000,$8008	8,9	I185, I186
5	0	2	$8000,$8008	12,13	I187, I188
6	0	6	$8000,$8008, $8010,$8018, $8040,$8048	0,1, 4,5, 8,9	I181, I182, I183, I184, I185, I186
7	0	8	$8000,$8008, $8010,$8018, $8040,$8058, $8050,$8058	0,1, 4,5, 8,9, 12,13	I181, I182, I183, I184, I185, I186, I187, I188
8	2	0		2,3	
9	2	0		6,7	
10	2	0		10,11	
11	4	0		2,3,6,7	
12	6	0		2,3,6,7,10,11	
13	1	0		11	
14 (Ring Order)	0	0	$8000,$8008, $8010,$8018, $8040,$8058, $8050,$8058 (if two Servo ICs)	None	I181, I182, I183, I184, I185, I186, I187, I188
15 (Equivalent to a $$$***)	1	0		11	

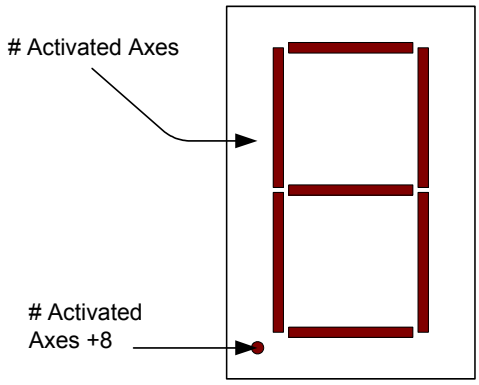
SW2: MACRO IC 0 Master Number Select

0: Commanded from Master IC # 0
1: Commanded from Master IC # 1
…
F: Commanded from Master IC # F (15)

CHARACTER DISPLAY AND LEDS

The MACRO Station has a single hexadecimal character display on the CPU/Interface Board that provides useful information as to the status of the station. The display indicates how many motors are activated and displays certain types of failures that might occur. One unique feature on the display is the LED dot in the bottom left corner. When this LED is illuminated, that means 8 must be added to the number being displayed. For example, if the display reads 4 and the LED dot is illuminated, that would mean that there are 12 axes enabled at the 16-Axis MACRO CPU. The display can show the following values:

Value	Meaning
(Blank)	Ring not active
0-8	Operation OK; value is # of motors enabled
9	(Reserved for future use)
A	Amplifier fault
B	Ring break fault
C	CPU failure fault
D	Ring data error
E	Loss-of-encoder fault
F	Other failure
Dot	Add 8 to the number of enabled Axes



Note:

The display can be read at the Ultralite with MI974. This is useful especially for user interface programs and for systems that are in inconvenient locations to read the display.

There are also three LEDs on the front panel (left adjacent to the seven-segment LED display) indicating the following:

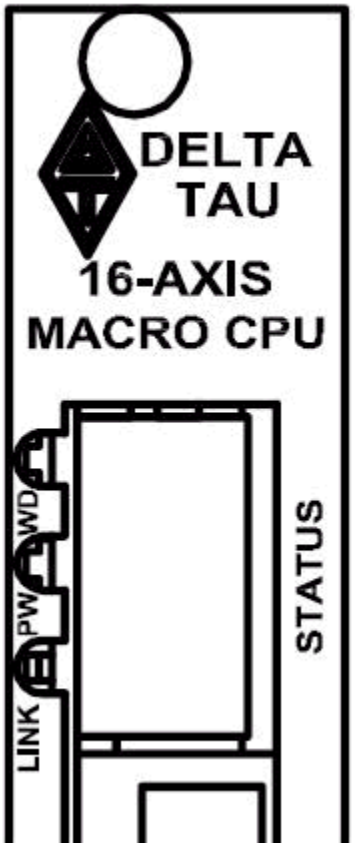
D7 (PW) – Green Power LED indicating the +5V is on and OK.

D8 (WD) – Red WATCHDOG LED indicating a watchdog condition.

D12 (LINK) – Dual Color MACRO Link Activity Indicator

Green = Link OK

Red = Link FAULT



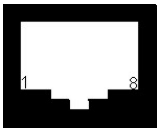
CONNECTOR PINOUTS

The schematic circuits shown in this section are for interface reference only. Subtle differences may exist between the circuits shown here and the actual hardware used. The connectors on the 16-Axis MACRO CPU are found on both the main (603719-10x) board and on an I/O daughter card (603720-10x) that plugs into the main board.

Main Board Connectors (603719)

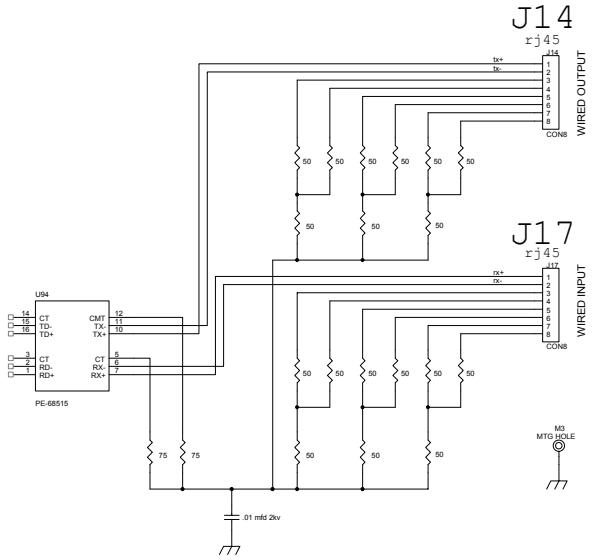
J14, J17: MACRO Copper I/O (OPT C)

(8 pin RJ45)



Front View

Pin #	Symbol	Function	Description	Notes
1	DATA+	Data +	Differential MACRO Signal	J17: DATA+ input J14: DATA+ output
2	DATA-	Data -	Differential MACRO Signal	J17: DATA- input J14: DATA- output
3	Unused		Unused terminated pin	See schematic below
4	Unused		Unused terminated pin	See schematic below
5	Unused		Unused terminated pin	See schematic below
6	Unused		Unused terminated pin	See schematic below
7	Unused		Unused terminated pin	See schematic below
8	Unused		Unused terminated pin	See schematic below
The cable used for MACRO wired connections is CAT5 verified straight-through 8 conductor.				



Circuitry for J14 and J17- Copper MACRO I/O

U73: MACRO Fiber Optic Connector (OPT A)

(2 Socket SC-Style)

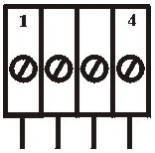
Front View

Pin #	Symbol	Function	Description	Notes
1	RX	Fiber Input	MACRO Ring Receiver	
2	TX	Fiber Output	MACRO Ring Transmitter	

1. The fiber optic version of MACRO uses 62.5/125 multi-mode glass fiber optic cable terminated in an SC-style connector. The optical wavelength is 1,300nm.
2. It is possible to adapt wire to fiber operation when using OPT A and C on the same MACRO CPU board.

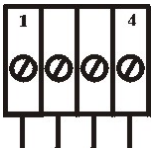
TB1: (JPWR) 4-Pin Terminal Block

(Location B-4)



Pin #	Symbol	Function	Description	Notes
1	GND	Common	Reference Voltage	
2	+5V	Input	Positive Supply Voltage	Supplies all PMAC digital circuits
3	+15V	Input	Positive Supply Voltage	+12V to +15V; used for on-board analog
4	-15V	Input	Negative Supply Voltage	-12 to –15V; used for on-board analog

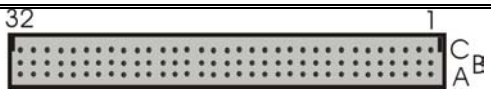
TB2: (JWD) 4-Pin Terminal Block



Pin #	Symbol	Function	Description	Notes
1	NC	Output	Normally Closed	
2	COM	Input	Common Input	
3	NO	Output	Normally Open	
4	COM	Input	Common Input	

P1: UBUS Interface Connector

(96 pin Euro Connector at F-1, 2, 3, 4)



Front View on MACRO CPU Card

Pin #	Row A	Row B	Row C
1	+5Vdc	+5Vdc	+5Vdc
2	GND	GND	GND
3	BD01	DAT0	BD00
4	BD03	SEL0	BD02
5	BD05	DAT1	BD04
6	BD07	SEL1	BD06
7	BD09	DAT2	BD08
8	BD11	SEL2	BD10
9	BD13	DAT3	BD12
10	BD15	SEL3	BD14
11	BD17	DAT4	BD16
12	BD19	SEL4	BD18
13	BD21	DAT5	BD20
14	BD23	SEL5	BD22
15	BS1 (GND)	DAT6	BS0 (GND)
16	BA01	SEL6	BA00
17	BA03	DAT7	BA02
18	BX/Y	SEL7	BA04 (n.c.)
19	CS3-	BA06 (n.c.)	CS2-
20	BA05 (CS7-)	BA07 (n.c.)	CS4- (CS6-)
21	CS12-	BA08 (n.c.)	CS10-
22	CS16-	BA09 (n.c.)	CS14-
23	BA13 (n.c.)	BA10 (n.c.)	BA12 (n.c.)
24	BRD-	BA11 (n.c.)	BWR-
25	BS3 (GND)	MEMCS0- (n.c.)	BS2 (GND)
26	n.c.	MEMCS1- (n.c.)	RESET
27	PHASE+	n.c.	SERVO+
28	PHASE- (n.c.)	n.c.	SERVO- (n.c.)
29	GND	n.c.	GND
30	-15Vdc	PWRGUD (n.c.)	+15Vdc
31	GND	GND	GND
32	+5Vdc	+5Vdc	+5Vdc

1. Refer to the UBUS Specification for detailed signal descriptions. This interface is not VME bus compatible.
2. Items shown in parentheses represent pin descriptions for -104 and earlier revision MACRO CPU boards.

Daughter Board Connections (603720)

J2 (JDISP) Display Connector

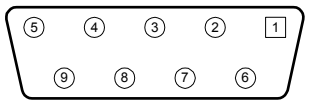
Pin #	Symbol	Function	Description	Notes
1	+5V	Output	Logic Power	Power supply out
2	GND	Common	Logic Ground	
3	RS	Output	Read strobe	TTL signal out
4	Vee	Output	Contrast adjust VEE	0 to +5Vdc *
5	E	Output	Display enable	High is enable
6	R/W -	Output	Read or write	TTL signal out
7	DB1	Output	Display data1	
8	DB0	Output	Display data0	
9	DB3	Output	Display data3	
10	DB2	Output	Display data2	
11	DB5	Output	Display data5	
12	DB4	Output	Display data4	
13	DB7	Output	Display data7	
14	DB6	Output	Display data6	
The JDISP connector is used to drive the 2-line x 24-character (Acc-12), 2 x 40 (Acc-12A) LCD, or the 2 x 40 vacuum fluorescent (ACC 12C) display unit. The **`DISPLAY`** command may be used to send messages and values to the display.				

J3 (JHW) Handwheel Encoder Connector

Pin #	Symbol	Function	Description	Notes
1	GND	Common	Reference voltage	
2	+5V	Output	Supply voltage	To power external circuitry
3	HWA1+	Input	HW positive A channel	Also pulse input
4	HWA1-	Input	HW negative A channel	Also pulse input
5	HWB1+	Input	HW positive B channel	Also direction input
6	HWB1-	Input	HW negative B channel	Also direction input
7	HWA2+	Input	HW positive A channel	Also pulse input
8	HWA2-	Input	HW negative A channel	Also pulse input
9	HWB2+	Input	HW positive B channel	Also direction input
10	HWB2-	Input	HW negative B channel	Also direction input
11	PUL1+	Output	PFM positive pulse	Also PWM bottom output
12	PUL1-	Output	PFM negative pulse	Also PWM bottom output
13	DIR1+	Output	PFM positive dir out	Also PWM top output
14	DIR1-	Output	PFM negative dir out	Also PWM top output
15	PUL2+	Output	PFM positive pulse	Also PWM bottom output
16	PUL2-	Output	PFM negative pulse	Also PWM bottom output
17	DIR2+	Output	PFM positive dir. out	Also PWM top output
18	DIR2-	Output	PFM negative dir out	Also PWM top output
19	GND	Common	Reference voltage	
20	+5V	Output	Supply voltage	To power external circuitry
The VHW connector provides for two 2-channel encoder inputs and two sets of pulse outputs.				

J4: (JRS232) Serial Port Connector

DB9-pin Female



Pin #	Symbol	Function	Description	Notes
1	N.C.		No connection	
2	TXD/	Output	Send Data	Transmit data to host
3	RXD/	Input	Receive Data	Receive data from host
4	DSR	Bidirect	Data Set Ready	Just tied to DTR
5	GND	Common	MACRO Common	
6	DTR	Bidirect	Data Terminal Ready	Just tied to DSR
7	CTS	Input	Clear to Send	Host Ready bit
8	RTS	Output	Request to Send	PMAC Ready bit
9	N.C.		No connection	

HARDWARE MEMORY MAP

The values in this table represent the hardware locations associated with register-based transactions that occur in the 16-Axis MACRO CPU.

Reference	ADDR (hex)	Description
CS00-	$FFC0	Stack I/O select #1 (not used with MACRO 16-Axis CPU)
CS02-	$FFC8	Stack I/O select #2 (not used with MACRO 16-Axis CPU)
CS04-	$FFD0	Stack I/O select #3 (not used with MACRO 16-Axis CPU)
CS06-	$FFD8	Stack I/O select #4 (not used with MACRO 16-Axis CPU)
CS0-	$C000	Stack axis 1-4 select (not used with MACRO 16-Axis CPU)
CS1-	$C020	Stack axis 5-8 select (not used with MACRO 16-Axis CPU)
CS2-	$8000	UBUS backplane axis 1-8 select
CS3-	$8040	UBUS backplane axis 5-8 select
CS4-	$C080	On-board DSPGATE2 select
CS4X-	$C0C0	UBUS backplane MACROGATE or DSPGATE2 select (CS4- on UBUS)
CS10-	$8800,$9800 $A800,$B800	UBUS backplane I/O select #1
CS12-	$8840,$9840 $A840,$B840	UBUS backplane I/O select #2
CS14-	$8880,$9880 $A880,$B880	UBUS backplane I/O select #3
CS16-	$88C0,$98C0 $A8C0,$B8C0	UBUS backplane I/O select #4
MEMCS0-	$D000	UBUS hardware I/O field (was DPRCS-)
MEMCS1-	$E000	UBUS hardware I/O field (was VMECS-)

The addressing field size is 16-bits in the 3U 16-Axis MACRO CPU. The address table above is similar to the PMAC2 product line.

ACCESSORIES

Both the Turbo and the 16-Axis MACRO CPU boards can support either the Stack or the UMAC configuration. The systems are configured modularly with the selection of a series of accessory boards, some appropriate for the Stack and some appropriate for the UMAC. These accessories are listed here. Each has its own manual with detailed descriptions.

The following table shows 3U products by function:

16-Axis MACRO CPU Board Options	**Board must be ordered with either Option A or Option C**	**Option A, fiber-optic connectors**	**Option C, RJ-45 electrical MACRO connectors**
UMAC Backplane-Mountable Accessory Boards – Axis	Acc-24E2, 2-Axis Digital PWM, 3x0-603397-10x Option 1A, Additional 2-Axis Analog, 3A1-603398-10x	Option 1D, Additional 2-Axis Digital PWM, 3D1-603397-10x Acc-24E2S, 4-Axis Stepper, 3x0-603441-10x	Acc-24E2A, 2-Axis Analog, 3x0-603398-10x
UMAC Backplane-Mountable Accessory Boards – I/O	Acc-65E, Acc-66E, Acc-67E Acc-11E, Isolated 24-In/24-Out Board, 3x0-603307-10x	Acc-9E, 48 In, 3x0-603283-10x Acc-12E, Isolated 24-In/24-High-Power Out Board, 3x0-603277-10x	Acc-10E, Isolated 48-Output Board, 3x0-603299-10x Acc-14E, 48 I/O, 3x0-603472-10x
UMAC Backplane-Mountable Accessory Boards – Communication	Acc-72E, (UNET) Universal Field Bus Adapter Network Card		
UMAC Backplane-Mountable Accessory Boards – Miscellaneous	Acc-28E, 16-Bit A/D, 3x0-603404-10x Acc-53E, SSI, 3x0-603360-10x Acc-58E, R/D Converter, 16 Bit, 3x0-603482-10x	Acc-36E, A/D, D/A Converter, 3x0-603483-10x Acc-56E, Extender Card, 300-603401-10x	Acc-51E, X 4096 Interpolator, 3x0-603438-10x Acc-57E, Yaskawa or Mitsubishi ABS, Encoder Unit, 3x0-603484-10x
UBUS Backplane Boards	Acc-U4, UBUS 4-Slot Backplane, 300-603462 Acc-U10, UBUS 10-Slot Backplane, 300-603464-10x Acc-U16, UBUS 16-Slot Backplane, 300-603471-10x	Acc-U6, UBUS 6-Slot Backplane, 300-603403-10x Acc-U12, UBUS 12-Slot Backplane, 300-603465-10x Acc-U18, UBUS 18-Slot Backplane, 300-603491-10x	Acc-U8, UBUS 8-Slot Backplane, 300-603463-10x Acc-U14, UBUS 14-Slot Backplane, 300-603466-10x
Amplifiers – Analog ±10VDC Input (Brush Motors)	4-Axis Analog ± 10V Input Linear Amplifier, 24VDC, 0.5/1A, 300-603489-10x Backplane, Double Analog Amplifier, 300-603470-10x	4-Axis Analog ± 10V Input PWM Amplifier, 48VDC, 2/4A, 300-603443-10x Backplane, Single Analog Amplifier, 300-603490-10x	4-Axis Analog ± 10V Input PWM Amplifier, 70VDC, 8/12A, 300-603486-10x
Amplifiers – Digital PWM Input (brushless)	2-Axis Digital PWM Amplifier, 360VDC, 4/8A, 400-603391-10x Single-Axis Digital PWM Amplifier, 360VDC, 8/16A, 401-603492-10x	2-Axis Digital PWM/Macro Amplifier, 360VDC, 8/16A, 400-603392-10x Power Supply for 3U Digital PWM Amplifiers, 400-603428-10x	Single Axis Digital PWM/Macro Amplifier, 360VDC, 8/16A, 401-603391-10x Backplane, Digital PWM, 300-603435-10x

16-Axis MACRO CPU Board Options	**Board must be ordered with either Option A or Option C.**	**Option A, fiber-optic connectors**	**Option C, RJ-45 electrical MACRO connectors**
Power Supplies – DC Input	Acc-F, 3U DC to DC Converter, 10A, 30F-603216-OPT		
Power Supplies – AC Input	Acc-E, 3U AC Power Supply, 8A, 30E-603269-OPT	Acc-E1, 3U AC Power Supply, 14A, 31E-603269-OPT	Acc-E2, AC Power Supply, 20A, 32E-603468-OPT
UMAC Chassis Assemblies (Rack)	3U Rack, 10-1/2 Slot (42T) 542-602932-10x 3U Rack, Variable Width per Customer Requirements (custom design), 500-602932-10x	3U Rack, 15-3/4 Slot (63T) 563-602932-10x	3U Rack, 21 Slot (84T) 584-602932-10x

DECLARATION OF CONFORMITY

Application of Council Directive: 89/336/EEC, 72/23/EEC

Manufacturers Name:	Delta Tau Data Systems, Inc.
Manufacturers Address:	21314 Lassen Street Chatsworth, CA 91311 USA

We, Delta Tau Data Systems, Inc. hereby declare that the product

Product Name:	MACRO16 CPU
Model Number:	603719

And all of its options conforms to the following standards:

EN61326: 1997	Electrical equipment for measurement, control, and laboratory use- EMC requirements
EN55011: 1998	Limits and methods of measurements of radio disturbance characteristics of information technology equipment
EN61010-1	Electrical equipment for measurement, control, and laboratory use- Safety requirements
EN61000-3-2 :1995 A14:1998	Limits for harmonic current emissions. Criteria A
EN61000-3-3: 1995	Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16A. Criteria B.
EN61000-4-2:1995 A1: 1998	Electro Static Discharge immunity test. Criteria B
EN61000-4-3: 1995 A1: 1998	Radiated, radio-frequency, electromagnetic field immunity test. Criteria A
EN61000-4-4: 1995	Electrical fast transients/burst immunity test. Criteria B
EN61000-4-5: 1995	Surge Test. Criteria B
EN61000-4-6: 1996	Conducted immunity test. Criteria A
EN61000-4-11: 1994	Voltage dips test. Criteria B and C

Date Issued:	11 May 2006
Place Issued:	Chatsworth, California USA

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Mark of Compliance

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